MATERIAL SAFETY DATA SHEET

SRM Supplier: National Institute of Standards and Technology
Standard Reference Materials Program
Bldg. 202 Rm. 211
Gaithersburg, Maryland 20899

SRM Number: 3169
MSDS Number: 3169
SRM Name: Zirconium Standard Solution
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SECTION I. MATERIAL IDENTIFICATION

Material Name: Zirconium Standard Solution

Description: SRM 3169 is a 50 mL single element solution prepared gravimetrically to contain a nominal 10 mg/g of zirconium with an approximate nitric acid and hydrofluoric acid combined volume fraction of 10 % and 2 %, respectively.

Other Designations: Zirconium* in **Nitric Acid** (aqua fortis; hydrogen nitrate; azotic acid; engravers acid)/**Hydrofluoric Acid** (hydrogen fluoride; fluorhydric acid) in **Standard Solution**

Name	Chemical Formula	CAS Registry Number
Nitric Acid	HNO_3	7697-37-2
Hydrofluoric Acid	HF	7664-39-3
Zirconium	Zr	7440-67-7

DOT Classification: Corrosive Liquid, Toxic
N.O.S. (Nitric Acid and Hydrofluoric Acid) UN2922

Manufacturer/Supplier: It is available from a number of suppliers.

*The addition of zirconium to hydrofluoric acid and nitric acid, along with other intermediate chemical reactions, forms zirconium compounds which will precipitate upon evaporation or drying of the solution.

SECTION II. HAZARDOUS INGREDIENTS

Hazardous Components	Nominal Concentration (%)	Exposure Limits and Toxicity Data
Nitric Acid	10	ACGIH TLV-TWA: 2 mg/kg or 5 mg/m^3
		OSHA TLV-TWA: 2 mg/kg or 5 mg/m^3
		Human, Oral: LD_{LO}: 430 mg/kg
Hydrofluoric Acid	2	ACGIH Ceiling: 3 mg/kg or 2.5 mg/m^3
		OSHA TLV-TWA: 3 mg/kg or 2.5 mg/m^3
		Man, Oral: TD_{LO}: 143 mg/kg
		Human, Inhalation: LC_{LO}: 50 mg/kg/30 min
		Man, Inhalation: TC_{LO}: 100 mg/m^3/5 min
Zirconium	1	ACGIH TLV-TWA: 5 mg/m^3
		OSHA TLV-TWA: 5 mg/m^3

SECTION III. PHYSICAL/CHEMICAL CHARACTERISTICS

Nitric Acid	Hydrofluoric Acid	Zirconium
Appearance and Odor: a colorless to slightly yellow liquid that darkens to a brownish color upon aging and exposure to light; irritating, pungent odor	**Appearance and Odor:** a colorless, fuming liquid with a strong, irritating, pungent odor	**Appearance and Odor:** gray amorphous powder
Relative Molecular Mass: 63.02	**Relative Molecular Mass:** 20.01	**Relative Atomic Mass:** 91.22
Density: 1.0543 (10 % nitric acid)	**Density:** 0.987 to 0.991	**Density:** 6.5
Solubility in Water: soluble	**Solubility in Water:** soluble	**Solubility in Water:** insoluble
Solvent Solubility: decomposes in alcohol.	**Solvent Solubility:** soluble in alcohol, benzene, toluene, *m*-xylene, and tetralin	**Solvent Solubility:** soluble in hot, concentrated acids

NOTE: The physical and chemical data provided are for the pure components. Physical and chemical data for this zirconium/hydrofluoric acid/nitric acid solution do not exist. The actual behavior of the solution may differ from the individual components.

SECTION IV. FIRE AND EXPLOSION HAZARD DATA

Flash Point: N/A **Method Used:** N/A **Autoignition Temperature:** N/A

Flammability Limits in Air (Volume %): **UPPER:** N/A
LOWER: N/A

Unusual Fire and Explosion Hazards: Although nitric acid does not burn, it is a powerful oxidizing agent that can react with combustible materials to cause fires. Hydrofluoric acid is a negligible fire hazard when exposed to heat and/or flames. Hydrofluoric acid may ignite or explode on contact with combustible materials. Zirconium is very explosive in the presence of oxidizing agents.

Extinguishing Media: Use extinguishing media that is appropriate to the surrounding fire. Use a water spray to dilute nitric acid and to absorb liberated oxides of nitrogen.

Special Fire Procedures: Fire fighters should wear a self-contained breathing apparatus (SCBA) with a full face piece in the pressure-demand or positive-mode and other protective clothing.

SECTION V. REACTIVITY DATA

Stability: **__X__ Stable** **_____ Unstable**

Conditions to Avoid: Avoid contact with combustible and other incompatible materials.

Incompatibility (Materials to Avoid): Avoid contact with acids, bases, amines, halogens, halo carbons, cyanides, metals, metal oxides, metal salts, metal carbides, peroxides, oxidizing materials, and reducing agents.

See Section IV: *Unusual Fire and Explosion Hazards*

Hazardous Decomposition or Byproducts: Hazardous decomposition of nitric acid and can produce various nitrogen oxides, including nitric oxide (NO), nitrogen dioxide (NO_2), nitrous oxide (N_2O), as well as nitric acid mist or vapor. Thermal decomposition of hydrofluoric acid may release halogenated (fluorinated) compounds. Thermal decomposition of zirconium may release toxic and/or hazardous gases.

Hazardous Polymerization: _____ **Will Occur** __X__ **Will Not Occur**

SECTION VI. HEALTH HAZARD DATA

Route of Entry: __X__ **Inhalation** __X__ **Skin** __X__ **Ingestion**

Health Hazards (Acute and Chronic): Nitric Acid: Nitric acid may be fatal if inhaled, swallowed, or absorbed through skin. This material causes burns and is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin. Inhalation may be fatal as a result of spasm, inflammation, and edema of the larynx and bronchi, chemical pneumonitis, and pulmonary edema. Symptoms of exposure may include burning sensation, coughing, wheezing, laryngitis, shortness of breath, headache, nausea, and vomiting.

Hydrofluoric Acid: Hydrofluoric acid may be fatal if inhaled, swallowed, or absorbed through the skin. This material causes burns and is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin. Inhalation may be fatal as a result of spasm, inflammation, and edema of the larynx and bronchi, chemical pneumonitis, and pulmonary edema. Symptoms of exposure may include burning sensation, coughing, wheezing, laryngitis, shortness of breath, headache, nausea, and vomiting. Repeated exposure to low concentrations may cause nasal congestion, nosebleeds, sinus problems, and bronchitis.

Direct eye contact with hydrofluoric acid may range from mild irritation to corneal burns. If the solution is not promptly removed, permanent visual defects and blindness may result. Hydrofluoric acid burns are characterized by blanched appearance of the skin with excruciating pain. Both the liquid and the vapor can cause severe burns that may not be immediately painful or visible. Solutions less than 2 % may cause burns. The full extent of tissue damage may not exhibit itself for 12 h to 14 h after exposure. Hydrogen fluoride will penetrate the skin and attack the underlying tissues and bone. Profound hypocalcemia can sometimes occur with fatal results. Chronic effects can include changes in bones and joints in humans.

Zirconium and Zirconium Compounds: Pulmonary granulomas have been observed in zirconium workers. Some zirconium compounds may cause sensitization reactions in previously exposed persons. Repeated skin contact with some zirconium compounds have produced hypersensitivity granulomas characterized by dusky red-brown papules. The granulomas produced by insoluble zirconium salts may persist for years and are resistant to treatment, where as those produced by soluble salts usually disappear within a few months.

Zirconium and its salts generally have low systemic toxicity. Acutely poisoned animals showed progressive depression and decreased activity until death. Pathologic observations included kidney and liver lesions. Subacute doses of zirconium compounds produced weight loss, weakness, diarrhea, liver damage, and death in animals. Zirconium fluoride may react with moisture to form hydrofluoric acid.

Medical Conditions Generally Aggravated by Exposure: Nitric acid may cause eye disorders, respiratory disorders, and allergies. Hydrofluoric acid may cause bone, joint, or tooth disorders, kidney disorders, and respiratory disorders. Zirconium and zirconium compounds may cause skin disorders and allergies.

Listed as a Carcinogen/Potential Carcinogen:

	Yes	No
In the National Toxicology Program (NTP) Report on Carcinogens		X
In the International Agency for Research on Cancer (IARC) Monographs		X
By the Occupational Safety and Health Administration (OSHA)		X

EMERGENCY AND FIRST AID PROCEDURES:

Skin Contact: Remove contaminated shoes and clothing. Rinse affected area with large amounts of water followed by washing the area with soap and water. Watch for chemical irritations and treat them accordingly. Obtain medical assistance.

Eye Contact: Immediately flush eyes, including under the eyelids, with copious amounts of water for at least 15 min. Obtain medical assistance.

Inhalation: If inhaled, move the victim to fresh air. If breathing is difficult, give oxygen; if the victim is not breathing, give artificial respiration. Obtain medical assistance if necessary.

Ingestion: If ingestion occurs, wash out mouth with water. **DO NOT** induce vomiting. Obtain medical assistance immediately.

TARGET ORGAN(S) OF ATTACK:

Nitric Acid: skin, teeth, eyes, and upper respiratory tract

Zirconium and Zirconium Compounds: skin, skeletal system and upper respiratory tract (URT)

Hydrofluoric Acid: skin and skeletal system

SECTION VII. PRECAUTIONS FOR SAFE HANDLING AND USE

Steps to be taken in Case Material Is Released or Spilled: Notify safety personnel of spills. Surfaces contaminated with spills should be covered with soda ash or sodium bicarbonate to neutralize the acid. Place the neutralized material into containers suitable for eventual disposal, reclamation or destruction.

Waste Disposal: Follow all federal, state, and local laws governing disposal.

Handling and Storage: Provide general and local explosion proof ventilation systems to maintain airborne concentrations below the TLV. Provide approved respiratory apparatus for nonroutine or emergency use. Use an approved filter and vapor respirator when the vapor or mist concentrations are high. Wear gloves and chemical safety glasses where contact with the liquid or high vapor concentrations may occur. An eye wash station and washing facilities should be readily available near handling and use areas. Wash exposed skin areas thoroughly after handling.

NOTE: Contact lenses pose a special problem; soft lenses may absorb irritants and all lenses concentrate them. **DO NOT** wear contact lenses in the laboratory.

Store this material at room temperature.

SECTION VIII. SOURCE DATA/OTHER COMMENTS

Sources:

MDL Information Systems, Inc., MSDS *Nitric Acid*, 16 September 1999.
MDL Information Systems, Inc., MSDS *Hydrofluoric Acid*, 16 September 1999.
MDL Information Systems, Inc., MSDS *Zirconium*, 08 December 1998.
The Merck Index, 11th Ed., 1989.
The Sigma Aldrich Library of Chemical Safety Data, Ed. II, 1988.